



Aviation Investigation Final Report

Location:	Blairstown, New Jersey	Accident Number:	NYC01LA196
Date & Time:	July 31, 2001, 11:46 Local	Registration:	N6121S
Aircraft:	Air & Space 18A	Aircraft Damage:	Substantial
Defining Event:		Injuries:	2 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot of the gyroplane taxied into position, and held on the end of the runway. She then engaged the main rotor system and advanced the throttle. She brought the main rotor up to 120 rpm in flat pitch, and then advanced the throttle and changed the pitch on the main rotor blades from ground to flight, after which, the gyroplane entered ground resonance. The pilot reported that she changed the pitch of the main rotor system from flight, back to ground and closed the throttle. Witnesses reported the gyroplane bounced and rocked from side to side, and came to rest on its side. The main rotor system separated from the rotor mast. A two piece friction fit sleeve for main rotor pitch control had separated. There was no evidence of recent wear on the threads in front of the nuts that held the sleeve together. The hydraulic blade dampers had separated from the main rotor blades and were not recovered. The gyroplane had been operated 0.7 hours since the last annual inspection, which had been conducted by the pilot. In addition, she declined to be interviewed by the Safety Board about the accident, and did not report any flight experience in make and model. However she was rated in both airplanes and rotorcraft, and also held flight instructor ratings in those models.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: An encounter with ground resonance for undetermined reasons.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: STANDING - IDLING ROTORS

Findings

1. (C) GROUND RESONANCE - ENCOUNTERED - PILOT IN COMMAND

Factual Information

On July 31, 2001, at 1146 eastern daylight time, an Air & Space America 18A gyroplane, N6121S, was substantially damaged while on the ground at Blairstown Airport, Blairstown, New Jersey. The certificated airline transport pilot and the passenger received minor injuries. No flight plan had been filed for the local flight. Visual meteorological condition prevailed for the personal flight conducted under 14 CFR Part 91.

In the NTSB form 6120.1/2, the pilot stated:

"Preflighted aircraft for an hour, taxi to end of runway for runup (rotors too long for taxiway)...engaged rotor system fully, advanced throttle, rotor went into ground resonance and I cut throttle."

According to an inspector from the Federal Aviation Administration (FAA), who interviewed the pilot:

"...[The pilot] completed the run-up (mags and prop checks included) without the main rotors turning. After the checks...[the pilot] moved the aircraft to the approach end of runway 7 to engage the rotors. She indicated that she engaged the rotors (fully), and had 120 rpm (on the rotor) / 1,000 rpm on the engine. As she advanced the throttle (towards full), the aircraft started to vibrate, going into ground resonance. As this started to happen...[the pilot] indicated that she de-pitched the rotor system and closed the throttle. This was confirmed by having no broken teeth on the shafts from the transmission / engine. The main tires 70 psi, the nose wheel had 35 psi, and the struts were 4 fingers exposed for the pre-flight."

According to a ground witness:

"The gyrocopter appeared to do a run-up at the west end of the runway. As the main rotor came up to speed, heavy vibration seemed to occur. The aircraft oscillated up and down, breaking off the right landing gear, rolling the aircraft first to the right, and when the rotor hit [the ground, the gyrocopter rolled] to the left."

A witness in the traffic pattern reported that he saw the gyroplane enter runway 7 and the pilot transmitted on UNICOM that she was going to do a run-up. As the rotor came up to speed, with no forward travel, oscillations began and that after the third or fourth oscillation the right wheel hit the ground and broke off. He further stated that the gyroplane rolled over and came apart.

The FAA inspector further reported that the gyroplane came to rest on its left side. The cockpit windows were shattered. The main rotor head separated from the main rotor mast. The tail boom and vertical stabilizers were bent, and the landing gear separated from the fuselage.

The upper and lower droop stops had evidence of multiple impacts. The friction fit sleeve fitting located below the swash plate, which was used to change the pitch on the main rotor blades, was separated, with the bolts still in place. Examination of the bolts revealed no evidence of recent wear on the threads. The hydraulic dampers on the three main rotor blades were not recovered.

According to the maintenance manual:

"The Air & Space 18A Gyroplane is a two-place craft...The seating arrangement is tandem; the landing gear is tricycle type with oleo shock struts and a fully castoring nose wheel. Lift is provided by an auto-rotating rotor.

Power is provided by a 180 horsepower Lycoming O-360 engine driving a pusher propeller. A clutch and transmission allow pre-rotation of the rotor in flat pitch to normal flight RPM for a jump take-off. A hydraulic system is used to hold the clutch engaged and the rotor in flat pitch. At the start of the take-off maneuver, the hydraulic pressure is released, disengaging the clutch and immediately allowing the blade pitch to increase to its flight position.

The rotor is of conventional three-hinge articulated design. Cyclic pitch control for pitch and roll is provided by a swashplate, and a two-position collective pitch control is provided to allow pre-rotation as described below. A...[delta] 3 angle incorporated in the flapping hinge-pitch control geometry provides the pitch change required from jump take-off to normal flight.

Yaw control is obtained from an all-moving rudder, centrally located in the triple tail unit."

"...The ground sensing device is a system for disconnecting the electrical source required to operate the hydraulic system and thereby making the hydraulic system in-operative in flight. Conversely, this same mechanism closes the circuit when the aircraft is on the ground."

According to the FAA inspector, the last annual inspection had been performed by the pilot, who also held a mechanics certificate with airframe and powerplant ratings and inspection authorization. Since the inspection, the gyroplane had accumulated 0.7 hours.

The pilot reported her total flight experience as 18,000 hours, including 6,000 hours in rotorcraft. She did not list any flight experience in make and model. The pilot declined to allow the FAA to examine her pilot logbook, and her flight experience was not verified. In addition, the pilot declined to be interviewed by the Safety Board about the accident, and it took multiple requests for her to complete the required NTSB form 6120.1/2. On her last airmen medical application dated June 14, 2001, she listed her total flight experience as 16,000 hours with 500 hours in the preceding 6 months. On her two preceding airmen medical applications dated June 26, 2000, and June 18, 1999, she listed her total flight experience as 15,000 hours, and 11,000 hours respectively, with 500 hours in the preceding 6 months each time.

According to the FAA Rotorcraft Flying Handbook, Chapter 21, Gyroplane Emergencies; Ground

Resonance:

"Ground resonance is a potentially damaging aerodynamic phenomenon associated with articulated rotor systems. It develops when the rotor blades move out of phase with each other and cause the rotor disk to become unbalanced. If not corrected, ground resonance can cause serious damage in a matter of seconds.

Ground resonance can only occur while the gyroplane is on the ground. If a shock is transmitted to the rotor system such as with a hard landing on one gear or when operating on rough terrain, one or more of the blades could lag or lead and allow the rotor system's center of gravity to be displaced from the center of rotation. Subsequent shocks to the other gear aggravate the imbalance causing the rotor center-of-gravity to rotate around the hub. This phenomenon is not unlike an out of balance washing machine....

To reduce the chance of experiencing ground resonance, every preflight should include a check for proper strut inflation, tire pressure, and lag-lead damper operation. Improper strut or tire inflation can change the vibration frequency of the airframe, while improper damper settings change the vibration frequency of the rotor.

If you experience ground resonance, and the rotor r.p.m is not yet sufficient for flight, apply the rotor brake to maximum and stop the rotor as soon as possible. If ground resonance occurs during takeoff, when rotor r.p.m is sufficient for flight, lift off immediately. Ground resonance cannot occur in flight, and the rotor blades will automatically align themselves once the gyroplane is airborne. When prerotating the rotor system prior to takeoff, a slight vibration may be felt that is a very mild form of ground resonance. Should this oscillation amplify, discontinue the prerotation and apply maximum rotor brake."

According to the maintenance manual, a rotor brake was an optional item. According to the FAA inspector who examined the gyroplane, there was no rotor brake installed.

Pilot Information

Certificate:	Airline transport; Commercial; Flight engineer; Flight instructor	Age:	32, Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land; Multi-engine sea	Seat Occupied:	Front
Other Aircraft Rating(s):	Glider; Gyroplane; Helicopter	Restraint Used:	
Instrument Rating(s):	Airplane; Helicopter	Second Pilot Present:	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Glider; Gyroplane; Helicopter; Instrument airplane; Instrument helicopter	Toxicology Performed:	No
Medical Certification:	Class 2 Valid Medical—no waivers/lim.	Last FAA Medical Exam:	June 14, 2001
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	April 5, 2001
Flight Time:	18000 hours (Total, all aircraft), 17500 hours (Pilot In Command, all aircraft), 300 hours (Last 90 days, all aircraft), 100 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Air & Space	Registration:	N6121S
Model/Series:	18A	Aircraft Category:	Gyroplane
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	1827
Landing Gear Type:	Tricycle	Seats:	2
Date/Type of Last Inspection:	May 4, 2001 Annual	Certified Max Gross Wt.:	1800 lbs
Time Since Last Inspection:	1 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	2739 Hrs at time of accident	Engine Manufacturer:	Lycoming
ELT:		Engine Model/Series:	O-360-A1D
Registered Owner:	Kim A. Darst	Rated Power:	180 Horsepower
Operator:		Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	ABE,394 ft msl	Distance from Accident Site:	28 Nautical Miles
Observation Time:	11:51 Local	Direction from Accident Site:	238°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	/	Turbulence Type Forecast/Actual:	/
Wind Direction:		Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.29 inches Hg	Temperature/Dew Point:	22°C / 13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Blairstown, NJ (1N7)	Type of Flight Plan Filed:	None
Destination:	(1N7)	Type of Clearance:	None
Departure Time:	11:46 Local	Type of Airspace:	Class G

Airport Information

Airport:	Blairstown Airport 1N7	Runway Surface Type:	Asphalt
Airport Elevation:	372 ft msl	Runway Surface Condition:	Dry
Runway Used:	7	IFR Approach:	None
Runway Length/Width:	3100 ft / 70 ft	VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	1 Minor	Aircraft Damage:	Substantial
Passenger Injuries:	1 Minor	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Minor	Latitude, Longitude:	40.969165,-75.002502

Administrative Information

Investigator In Charge (IIC):	Hancock, Robert
Additional Participating Persons:	Rod Bourey; Federal Aviation Administration; Allentown, PA
Original Publish Date:	June 3, 2002
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=52901

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The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).